

Plate I.—*STRIGA* AS A ROOT PARASITE OF SUGARCANE.

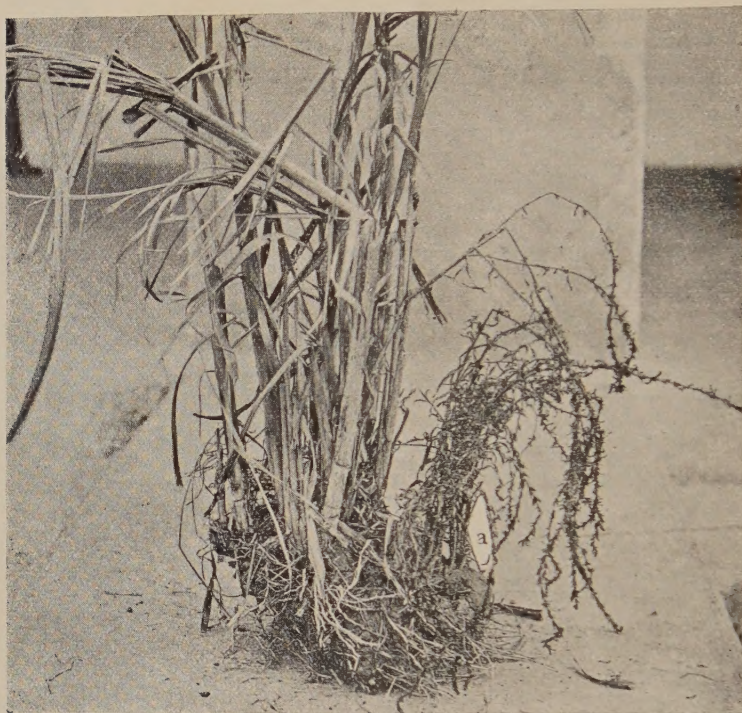


Fig. 1. A sugarcane plant killed by *Striga densiflora* (a) attached to its roots.



Fig. 2. A shoot of *Striga densiflora* (a) attached to the roots of cane.



Fig. 3. *Striga densiflora* with a few of its off-shoots.

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Feeding Experiments with Ground-nut Oil-cake.

(PRELIMINARY REPORT.)

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The Chemical analysis of ground-nut cake ranks it as the highest of all similar feedstuffs from a nitrogenous standpoint, with a crude protein content of almost 50% and a carbo-hydrate and fat content of 22% and 7% respectively. The price of this cake per ton also compares favourably with that of other oil-cakes on the local market, as well as abroad, and the supply is a fairly good one.

In those countries of the Western Hemisphere, where ground-nut cake is available, it is esteemed as a good nitrogenous concentrated feed for cattle of all kinds, and readily used for that purpose; the amount fed running up to as much as 5 lbs. or more per diem. In suitable quantities it is also fed to young stock. Provided that the material is fresh and pure, it is not found to have any bad influence on the animals to which it is fed.

In Mysore, ground-nut cake, although it is fed to cattle in some cases, is not regarded favourably as a cattle feed and certain objections are made to its use. In order that some idea might be obtained as to the effects of feeding this cake to cattle, for different periods, a

series of preliminary experiments were started on the Rayankere (Palace) Dairy Farm near Mysore

The animals available were of unknown age, on account of the fact that they had been purchased with their dams. They were approximately of the same age as far as appearances indicated, and were about eight months old when the experiment was started. They were all of the Sind breed, but no information was available as to their breeding, except that their dams were known in each case.

Twenty calves of both sexes were selected for the purpose and were put on preliminary rations, consisting of green grass and wheat bran for a fortnight. During this period they were weighed every morning at about 8 A.M. after receiving their morning rations. The figures obtained are given in Table 1. The weights for the first 3 or 4 days were unusually variable, for the reason that the process of being weighed was a new experience to them. Moreover, the animals were also tied up for the first time, as they had previously been housed in loose boxes. They were maintained on the same rations for a further period of 7 days and weighed again on 3 consecutive days at about 8 A.M. in the morning. These weights are also given in Table 1. The average weights of each animal during the last three days varied between 168 and 280 lbs. The whole lot was now divided into 2 groups, each group consisting of 5 heifers and 5 bulls. The grouping was so made that the one group was as similar to the other as possible. The total weights of the 2 groups were as follows :—

	Group A.	Group B.
5 Heifers ..	1124 lbs.	1099 lbs.
5 Bulls ..	1177 lbs.	1195 lbs.
Total ..	2301 lbs.	2294 lbs.

After the groups were so constituted on 12th July 1921, the differential feeding with ground-nut cake began. Animals in both the groups got as much grass and other fodder as they could eat and one and a half pounds of wheat bran per day per head. Only animals in group B were given in addition one pound of ground-nut cake per head every day. It was originally thought to feed the A group on bran alone, and B group on cake alone, the amount given being based on their protein content. But as all the animals had become used to bran feeding for a certain length of time, it was thought that a discontinuing of the same would affect the condition of one group to a

TABLE 1.

Weight in lbs. on June														July			
Calf No.	20th	21st	22nd	23rd	24th	25th	26th	27th	28th	29th	30th	1st	2nd	11th	12th	13th	
61	251	257	261	258	257	257	259	264	270	276	264	266	272	283	278	279	
62	183	184	191	190	188	191	193	192	198	198	192	192	198	193	186	187	
63	233	234	241	236	238	238	238	243	244	242	239	237	244	249	249	241	
64	191	199	201	203	201	202	206	211	215	210	209	210	219	222	216	217	
66	228	224	231	233	233	233	235	233	240	241	235	231	244	250	247	250	
69	151	152	159	159	153	158	156	158	165	161	160	162	167	169	167	169	
72	187	194	202	198	202	198	198	204	205	208	204	204	210	215	215	216	
73	203	199	203	202	201	200	200	203	204	209	201	203	210	214	215	216	
84	250	263	255	256	257	253	253	256	261	261	260	262	264	276	272	272	
70	160	156	152	150	150	149	149	148	155	157	156	159	162	170	169	171	

Heifer Calves.

TABLE 1—(Continued).

Calf No.	Weight in lbs. on June												July			
	20th	21st	22nd	23rd	24th	25th	26th	27th	28th	29th	30th	1st	2nd	11th	12th	13th
71	251	250	255	257	255	257	257	258	263	264	252	257	262	268	264	270
77	228	229	237	230	230	229	229	231	231	227	226	225	229	237	238	241
79	176	177	184	179	183	182	185	187	189	187	187	181	190	198	200	200
80	248	251	259	253	256	253	254	254	259	262	259	258	263	266	270	270
86	228	230	231	231	236	235	233	237	238	237	236	236	236	248	249	249
Orphan	204	202	208	205	208	209	209	210	213	214	213	212	223	222	223	224
76	211	219	217	220	220	220	220	225	230	231	225	224	234	239	236	236
78	206	204	203	209	207	211	213	211	215	213	209	213	221	223	224	225
81	231	231	235	236	238	233	233	235	238	240	238	240	244	253	253	250
83	186	194	194	193	193	193	193	192	201	201	198	202	207	212	212	216

Bull Calves.

certain extent at least. Hence the modification of the original plan of experiment which does not give any information as to the relative value of wheat bran and oil-cake as concentrated feeds. The experiment only gives some information with regard to the effect of feeding of a small quantity of cake in addition to a normal feed consisting of grass and bran.

As already stated the feeding was started on 12th July 1921. The animals were weighed for three consecutive days in a period of every ten days, and the average weights obtained in each period till 15th October 1921 are given in Table 2.

From the tables it will be seen that the weight of 5 heifers fed on bran alone increased during the period under observation from 1124 lbs. to 1382 lbs., whereas that of those fed on bran and cake increased from 1099 to 1444 lbs. The increase in the first case is 258 lbs. or nearly 23% whereas in the second case it is 345 lbs. or 30%. During the same period the 5 bull calves in the bran series increased from 1177 lbs. to 1455 lbs. or slightly over 23% while those in the cake series increased from 1195 lbs. to 1577 lbs. or nearly 32%. Taking the heifers and bulls together it is seen that the 10 animals in the bran series increased in weight from 2301 lbs. to 2837 lbs. or slightly over 23% whereas those in the cake series increased from 2294 lbs. to 3021 lbs. or slightly over 31%. The period of experiment was 94 days and the increase in weight of the 10 animals in the bran series was 536 lbs., which gives an average increase of slightly over half a pound per head per day. The increase in the cake series was 727 lbs. or slightly beyond three-fourths of a pound per head per day. These facts show clearly that an addition of a small quantity of oil-cake to the daily rations (in this case 1 lb.) has had the effect of enabling the animals to put on nearly 50% more gain in weight.

The financial aspect of these results as obtained would seem to bear consideration. The average price of the ground-nut cake fed to these calves was under Rs. 80 per ton, which works out at exactly 28 lbs. per rupee. The cost of a week's ration of ground-nut cake for each animal was, on this basis, 4 annas. The average increase in weight due to the extra feeding of ground-nut cake during that period was $1\frac{3}{4}$ lbs., at a cost of 2 annas and 3 pies per lb. Over a period of six months (and present experience indicates that this gain could be expected to continue at the rate obtained), this system of feeding would

TABLE 2.

Weight in lbs. of calves fed on bran for period ending on

Heifers	13-7-21	23-7-21	4-8-21	13-8-21	23-8-21	3-9-21	13-9-21	24-9-21	5-10-21	15-10-21
61	280	284	294	298	311	310	317	327	335	335
63	246	254	273	271	278	279	283	295	303	309
72	215	219	231	232	245	245	250	259	263	265
69	168	171	181	183	194	195	198	206	206	207
73	215	218	230	231	243	246	251	262	259	266
Total	1124	1146	1209	1215	1271	1275	1299	1349	1366	1382
Bulls										
71	267	271	282	281	299	295	296	304	313	313
Orphan	223	228	241	240	250	249	255	263	274	275
86	249	253	266	266	281	279	290	300	301	312
77	239	241	253	260	271	261	271	283	280	287
79	199	207	221	224	236	233	247	254	261	268
Total	1177	1200	1263	1271	1337	1317	1359	1404	1429	1455

TABLE 2—(Continued).

Weight in lbs. of calves fed on bran and cake for period ending on										
Heifers	13-7-21	23-7-21	4-8-21	13-8-21	23-8-21	3-9-21	13-9-21	24-9-21	5-10-21	15-10-21
84	273	273	290	298	311	309	313	327	331	332
66	249	247	260	270	277	285	293	305	309	317
62	189	196	216	226	235	243	254	264	267	275
70	170	177	192	201	211	213	222	225	237	241
64	218	217	230	241	252	252	257	271	277	279
Total	1099	1110	1188	1236	1286	1302	1339	1392	1421	1444
Bulls										
80	269	273	291	297	309	303	310	328	337	338
78	224	229	245	256	269	273	284	294	310	314
81	252	257	273	279	284	286	290	301	305	311
76	237	246	263	272	282	288	295	308	312	323
83	213	220	236	241	253	254	264	284	290	291
Total	1195	1225	1308	1345	1397	1404	1443	1515	1554	1577

produce an extra increase in weight over the bran alone animals of 42 lbs. at a cost of approximately Rs. 6. It is difficult to estimate the increased value of an animal due to increased growth in any arbitrary way. It would however seem to be safe to assume that, other things, such as conformation, etc., being equal, an increase in the weight of an animal to the extent of 42 lbs., at say 12 months of age, would realize a greater increase in value than Rs. 6, provided the animal was worth anything at all.

There is in all likelihood a greater value than that of additional price to be attached to this increased growth in the early stages of the animals' existence, and that is the extreme probability of an earlier maturity and a quicker fecundity. This will be revealed as the experiment proceeds.

Till now the animals have been compared in groups and for the whole period of the experiment. The whole period consists of 9 smaller periods of about 10 days each and a glance at the Table 3 shows that the increase in weights during each of their smaller periods has not been uniform. The heifers as well as the bulls show irregularity in increase which therefore cannot be attributed to difference in sex. It must be due to other causes, such as weather conditions, which might have influenced the appetite of the animals for straw, grass and other rough fodder and a certain amount of variation in the quality of the grass fed. Owing to certain working difficulties it was not possible to get anything more than a rough idea of the quantity of fodder consumed by the animals. The increase in weight of the individual animals in each group given in Table 2 also shows a certain amount of variation ranging from 20 to 35% of its initial weight. This can be attributed to individual idiosyncrasy, as well as to hereditary influence. For example, the mothers of those animals are not of uniform weights, and so some calves would have an inherent tendency toward larger size and more rapid gain than others.

The experiment is being continued to ascertain if the feeding with oil-cake has any special influence on the maturity of the heifers and in hastening them in breeding. In addition, further experiments have been started with younger animals whose age and breed are definitely known. As far as possible, it will also be attempted to find out the utilization of the nutrients supplied to the animals as fodder and feed.

TABLE 3.

Showing increase in weight during periods of 10 days each									
<i>Bum series.</i>	13-7-21	23-7-21	4-8-21	13-8-21	23-8-21	3-9-21	13-9-21	24-9-21	5-10-21 15-10-21
Weight of 5 heifers	lbs. 1124	1146	1209	1215	1271	1275	1299	1349	1366 1382
Increase	..	22	63	6	56	4	24	50	17 16
Weight of 5 bulls	lbs. 1177	1209	1263	1271	1337	1317	1359	1404	1429 1455
Increase	..	23	63	8	66	-20	42	45	25 26
<i>Cake series.</i>									
Weight of 5 heifers	lbs. 1099	1110	1188	1236	1286	1302	1339	1392	1421 1444
Increase	..	11	78	48	50	16	37	53	29 23
Weight of 5 bulls	lbs. 1195	1225	1308	1345	1397	1404	1443	1515	1554 1577
Increase	..	30	83	37	52	7	39	72	39 32

An Entomologist's Tour round the World.

BY

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The Editor of the Journal has asked me to write a brief account of my tour round the world and I do so with pleasure. I do not believe any Entomologist in India has had quite the opportunity of studying Entomological work under such a variety of conditions as I have had given to me by the Government of H.H. the Maharaja of Mysore, and coming as it did after 12 years of work in the Entomological laboratories of the Department I had the additional advantage, which students fresh from Indian Universities do not have, of specialising in branches and directions which are likely to yield the most practical results to the State.

My programme was ambitious. It included study of the pink bollworm of cotton in Egypt, work with parasites under Professor Sylvestry in Naples, the authority in that branch of Entomology, visits to the laboratories of Prof. Marshall, another honoured name in Entomology, and visits to museums in London. In London I had the opportunity to attend the Imperial Entomological Conference where the papers and discussions gave me an insight into the problems confronting the Entomologists of the Empire. The programme as far as London occupied only three months. The bulk of the work that had been planned for me was in the United States which is justly considered ahead of every other country in the development of that science. I landed at Boston on the 14th of July and proceeded after a brief visit to the Bussey Institute of the Harvard University, to Washington where the Bureau of Entomology is situated. The Bureau is practically the brain of Entomological work in the States. Started as early as the eighties of the last century it has during the course of four decades built up a large reservoir of information on which Entomological workers in all parts of the world may draw unreservedly. Besides the laboratories at the capital, there are many more distributed over the various States in charge of capable men where work of inter-statal value is done. In one such branch devoted to the study of the cotton boll weevil there are not less than 120 Entomologists. In addition to the Bureau and the network of field stations established by it there are provincial Departments of Entomology attached to the agricultural colleges where work in which the

States are interested individually is carried on. The various Universities also have fully equipped Entomological laboratories of their own in which purely scientific work, often with an economic bearing, is done. The numerous Entomological societies, almost too numerous to mention, have a large membership drawn from almost all classes of society and with Journals of their own.

There has been thus and there is still going on a collection and diffusion of Entomological information for which there is no parallel anywhere else in the world. The value of economic Entomology is appreciated so widely that there have sprung in the States a class of professional men known as consulting Entomologists who on payment give advice regarding the location of new factories or give expert opinions in disputed cases regarding insect injury caused by existing factories to neighbouring crops. The growth of interest in Entomology is as much due to the facilities for information as to one's interest in the subject and such facilities exist in the numerous museums and publications that can often be had for the asking, so abundantly that a knowledge of insects is fairly general.

The phenomenal advance during a period of 40 years of a science practically unknown, into the very front rank of Agricultural Sciences is largely due to the initiative and enterprise of the United States. There have been however causes which have made a more rapid development of it possible there than elsewhere. In the first place the country is of such enormous extent, nearly twice the size of India, with such vast stretches of virgin land, such profusion of mineral resources that for a people in the main descended from the hardy stocks of Puritan England and not disposed to surrender to the amours of Nature, a development along lines of capitalism may be considered almost to have been predetermined. Industries on one side and Agriculture on the other have acted and re-acted one on another until in the space of a couple of centuries the United States presents the unique spectacle of a country of unexampled wealth. While farming became capitalistic, the crops raised were crops familiar to them in the "old country" which were introduced with little or none of the safeguards necessary to keep out the pests peculiar to them. The area of each farm ran often into hundreds of acres and the yield per acre stood at figures of which an Indian ryot dare not even imagine. The deficiency of labour compelled the introduction of machinery and

machine cultivation on a large scale rendered those other adjuncts of cultivation, spraying, etc., a matter of machinery too. Where the returns per acre ran into thousands of rupees and acreage is large, the expenditure of about Rs. 50 or 60 per acre is not likely to be viewed with disfavour. Introduced often with the pests along with them, the crops suffered a great deal more from their depredations there than in the old country and reliance on scientific assistance was compelled by this very condition.

I have thus detailed the important features of Agricultural development to bring home to readers the important fact that a policy of 'Copy' will not avail in the very widely different conditions of India. The development of Agriculture in India has been almost the reverse of that in the States and there have been circumstances in the political and economic history of India to prevent development except in narrow tracts and in case of special crops along lines of capitalistic farming. The average acreage of a farm is a bagatelle of 4 acres and the return per acre does not usually run beyond two figures. The Economic Entomologist has always to set before him these primary conditions and devise remedies that are adaptable to such conditions.

While however the remedies devised against insect pests in the States are for the most part too costly of application under Indian conditions, a method is being developed known as biological control which is not open to this objection. In this method greater reliance is placed on enemies and diseases of insects for combating them. A fair proportion of the pests in the United States are imported and have reached their present dimensions largely because they have been in their new home free from enemies which kept them in check in the place of their origin. The introduction of these will naturally tend to restore the balance of nature. The first notable success obtained by this method was in regard to the formidable pest known as the Cotton Cushion Scale which was brought under control by an Australian lady-bird beetle. Another pest of the Eastern States, the Gypsy moth, introduced in the mistaken belief that its cocoons would yield silk, is being controlled by parasites brought from Europe. Against a third pest, the European Corn Borer recently introduced, parasites are being reared in France and elsewhere for transmission to the States.

Under the same category as the above may be placed the destruction of insects by the artificial culture and spread of diseases to which they are liable. The introduction of varieties which are resistant to insect pests is another field full of possibilities. A third line is the discovery of suitable chemicals for the attraction of insects by their means, to effect more easily their destruction. The alteration of the normal course of generation, the modifications of its characteristics by means of chemicals applied to the plants on which the insects feed is another line of work which also deserves mention.

In regard to these various methods of insect control, a wealth of information is being rapidly accumulated which is of the utmost value to the Economic Entomologists. There is also the advantage of learning first-hand methods of organization and demonstration and last, but not least, the personal contact with the workers in the same field and the exchange of experiences tends to alter for the better one's outlook towards the insect problems and the methods of their solution.

I visited in all 23 field-stations of the Bureau. At every one of these the insects studied were insects attacking crops grown in India. After visiting these, I entered the Stanford University for my laboratory course. Stanford is considered to be in the very front rank of American Universities and the Entomological section has attained a considerable reputation. The authorities having agreed to admit me to the PH.D. degree on satisfying the minimum requirement of a stay of nine months at the university, it was decided to extend the laboratory course to that period and prepare a thesis for the degree.

My thesis related to the exposition, for the first time, of the principle governing the penetration by legless insects into hard material. It was shown that, in the absence of legs, insects were compelled to resort to various devices to effect entry into such material. The habits of several insects in this condition which has remained obscure were explained in the light of this principle and it was shown that it has important economic as well as scientific bearings.

Soon after taking the Degree, I proceeded to Hawaii where the entomological work done relies all but inclusively on parasite agency for the control of insect pests. The most important crop raised there is sugarcane and almost all the pests on this crop were kept under check by insects imported from nearly all parts of the world. Ento-

mologists for the Sugarcane Experimental Station have had to visit Australia, Fiji, China, Japan, India, Borneo and many other places to get hold of suitable parasites and their labours have met with considerable success in almost every case.

While at Hawaii I sent to India a consignment of lantana flies for introduction into the State. The home of lantana is Mexico where it is kept in check by a number of insects, among them a small fly multiplying in berries and rendering them unfit for seed. The flies did not spread along with lantana, and in various parts of the world, the lantana in the absence of the check flourishes so well that it has become a pest. The introduction of the fly is therefore likely to act as a check. About 250 flies have been liberated and their behaviour under the new conditions is being carefully watched.

While at Hawaii I also collected the seeds of a plant which is likely to prove most useful to India especially to parts of Mysore. The plant was originally an inhabitant of Brazil but on account of its usefulness it has been introduced all over the Southern parts of the United States. The tree grows to about 40 ft. high and yields when full grown about 100 to 200 lbs. weight of pods which are highly nutritive to cattle and much relished by them. Being specially adapted to semi-arid conditions its value as a safeguard against cattle famine is obvious. The timber is of good quality and the flowers yield large quantities of honey. A more detailed account of the tree will be published elsewhere.

From Hawaii I proceeded to Japan which as in many other things is abreast of the times in regard to the control of the insect pests. I visited the laboratories and was specially struck with the comprehensive publications in Japanese language on insect pests. From Japan onwards the tour was without incident worthy of record here. I landed at Colombo on the 29th October and joined my duties on the 1st of November 1921.

I have thus but very briefly brought together for the Journal the main features of my experience and work while on deputation. I have not attempted to go into any detail of observations made in each country and at each Entomological station. That would take me too long and besides, the highly technical matter is not likely to interest readers of the Journal. What I have given, however, will, I trust, give them some insight into the problems that an Entomologist

has to face and the variety of resources and methods he has to fall back upon to bring under control insects which but for vigilance and effort may threaten the supremacy of man.

Anabe Disease of the Areca palm (*Ganoderma Lucida*).

BY

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This is a disease attacking the areca trees, as well as the cocoanut, date and other palms. Till recently it was known to exist in Mysore *maidan*, but it has been reported from the *malnad* also where it seems to be just making its appearance in Kerodi near Tirthahally. It is interesting to note that the disease has been reported by Dr. Butler to attack areca trees in Sylhet in Assam. It is said to attack not only areca and other palms, but a number of forest trees like Hongey, Jambu, are also susceptible to this. The gold mohur tree just behind the office building seems to have been killed by its attack when the *anabes* brought from other places for examination were thrown out near it casually. As the anabe appears at the base of the tree generally after the tree is dead, and in exceptional cases a little earlier also, I have come to think that the disease attacks the trees through their roots.

The first indication of the appearance of the disease is that the topmost portion just below the place from which the leaves spring to a depth of 3 to 4 feet gets thinner, the leaves become yellow and hang down the sides, and in about a fortnight to a month the crest falls down. If the tree is in bearing the branches dry up soon after the appearance of the disease. The lower portion of the trunk gets slightly discoloured and a slight exudation is noticed.

Though the disease is said to exist in almost all the maidan taluks, the gardens of Amrithur seem to offer more favourable conditions for its spread than any other place in which enquiry has been made, including the areca gardens of other villages in Kunigal Taluk itself. From the information gathered with regard to the number of trees lost per year per garden, the nature of soil and sub-soil in which the disease is more virulent, the facilities for drainage, the methods of cultivation followed in different taluks of the Tumkur District, and the amount of light and air admitted into the gardens, the following inferences may be drawn.

1. The majority of gardens of Amrithur have impervious clayey sub-soils, and therefore there is more lack of sub-soil drainage here than in the other places in which enquiry has been made. This is proved by the absence of the disease in some of the gardens which have got an open sub-soil with plenty of kankar nodules. In another block adjacent to the bund of a tank a few gardens having gravelly soils and sub-soils, show the loss to be only 5 or 6 trees per year per acre.

2. The trench and platform system followed here, though an ideal one to effect free drainage, has not been conducive to its favour nor to the increase of yield, the cause of which should be ascertained.

3. In the villages of the other taluks of the Tumkur District, *viz.*, Kyathsandra and Gooloor of the Tumkur Taluk, Brahmasandra, Tarur, Kadavagere, Kallabella, Kuntagonahally and Sankapura of Maddagiri Taluk; Hosakere and Hagalvadi of Gubbi Taluk where only bed system is followed, the disease exists only in traces and none at all in Gamkarnahalli and Sankapura where the few gardens that exist are giving the highest yield in maidan, *viz.*, 60 maunds per acre. In another garden at Amrithur itself near the tank bund, which has gravelly soil, there are two lowlying patches which get the surface washes of the higher parts and which also have more trees than an equal area higher up, and in which not one tree has been lost within the last 10 years. The owner thinks that the depth of soil accumulated round the base of the tree may have something to do with the immunity maintained by these two patches. These trees are also said to yield comparatively more individually and collectively than the other trees higher up. He removes the tree as soon as the symptoms of the disease appear, heaps rubbish on the spot and burns the place the same day. Owing to the addition of new plants as a rule year by year whether there is room for them or not, and the spread of plantain trees, the amount of light and air admitted into the gardens is generally at its minimum. The application of lime tried on a leased garden has not been found useful. Like other diseases of its kind, this has also got the skipping habit from one corner of a garden to another, and cannot be isolated. Another melancholy aspect is that it attacks only young and vigorous trees which yield well.

In all villages of the taluks of Tumkur District including those to which mention has been made already, and in which

only bed system is followed from time immemorial, the sources of irrigation in seasons when the tanks go dry, which will generally be not less than half the year, are the wells; but in the case of Amrithur, the tank which is the only source at all seasons fortunately never goes dry and therefore keeps the soil always saturated with water and thus hinders drainage. Whether this difference has any bearing or not is to be investigated.

During May 1921, at the request of the garden owners, the Senior Assistant Mycologist started some experiment in one of the gardens as described below.

The garden has been divided into blocks A and B, and the trees in each have been numbered showing both the number of rows in each block and the number of trees in each row. All the trees dead previous to the date of the experiment were removed from the garden and their stumps dug up and burnt. The bases of such trees to a radius of 3 feet have been dug up and carbon bisulphide or formalin has been poured into the pits and covered up; from the number of trees found attacked on the 20th September last *i.e.*, 4 months after the starting of the experiment, the percentage of attacks works out at 20 per acre per year. At this rate, if no planting is made in place of those lost by disease, that whole garden of $3\frac{1}{2}$ acres which contains 1500 trees both young and old will be denuded in 25 years. With regard to the importance of the crop itself to the people of Amrithur in keeping them above the level of indebtedness as compared to that of the areca garden owners of other places in Mysore maidan, it must be said that the income from this industry is the mainstay of more than 50% of the people of Amrithur and the produce of these gardens including the basal portion of the areca leaf which is used in place of plates by Brahmins, and the cups of plantain leaves, fetches a high price in Madras which is the market for Amrithur. There are three or four men each owning 15 to 20 acres like those in malnad.

One of our Union members, Mr. Ramanuja Iyengar is, I think, the biggest areca garden owner possessing some 25 acres or so. The following figures of yields and loss due to the disease is found interesting :—

Area under the tank :

Garden 168 acres ; assessment 1,183 Rupees.

Wet 417 acres ; Assessment 2,418 Rupees.

No. of trees per acre—450.

Average number of trees bearing—400.

Total number of areca trees on 168 acres—67,200.

Average yield per tree per year,—5 seers or $\frac{1}{3}$ of a maund of finished product.

Total yield on the garden area—8,400 maunds : value of this at Rs. 15 per maund—Rs. 1,26,000.

Number of trees lost on account of anabe disease on the basis of Mr. Ramaswamy Iyengar's garden where account is kept since May 1921—20 trees per acre per year.

Number of trees lost from the whole garden area of 168 acres—3360 trees.

Total loss of yield in maunds from the above trees—420 maunds.

Value of annual loss—Rs. 6,300 ; percentage loss on total yield—5.

From the above facts it can be seen that arecanut is an important money crop to this village, and that the disease requires the same measure of investigation and experiment for combating it as is being followed in the case of Koleroga in the malnad.

In conclusion, I wish to thank Mr. M. K. Ramaswamy Iyengar, Secretary of the Agricultural Association at Amrithur for his kind help and interest in the work, and also to acknowledge the help given by Mr. M. J. Narasimhan.

Notes on the more Important Insect Pests of Crops in the Mysore State.

BY

T. V. Subramania Iyer,

Assistant Entomologist, Mysore Agricultural Department.

(Continued from our last issue.)

III. DIPTERA.

(1) Fruit Flies. Fam. Trypaneidæ.

Species damaging mangoes, guavas, peaches, melons, ribbed gourds (luffa), bitter gourds, cucumbers, etc., are found in the State. Three or four different species are the cause of the damage. In addition to the above a good number of different species have been noted breeding in a number of wild fruits in the hill forest areas of the State, viz., fruits

of *Diospyros montana* and *Gundala*. Fruit flies of sorts are found to breed continuously during the year, as some fruit or other is found throughout the year on which they breed.

(2) **Cowpea and Togare (Red gram) pod flies.**

Fam. Agromyzidæ.

(*S. S. I. I. p. 357-358.*)

These are very small flies probably belonging to two different species. One species lays a number of eggs on the stems of young cowpea plants. The maggots bore into the stems and develop there. The attacked plants are found wilting and drying up a few days after. This is an occasional serious pest of cowpeas in Bangalore.

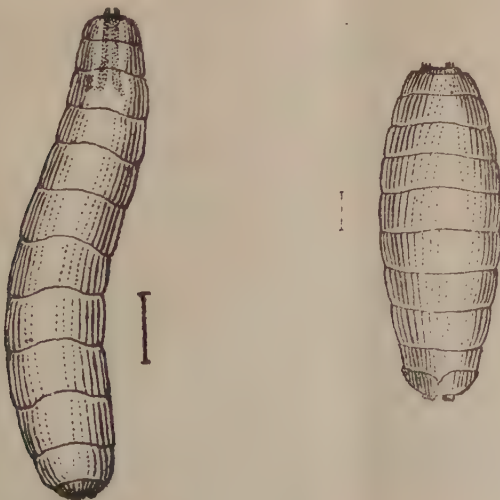
The other species of fly lays eggs by piercing the tender togare (red gram) pods. The maggots feed on the seeds inside and pupate there. The insect is very common in Bangalore but has not been noticed as a serious pest.

(3) **The Jola Seedling Fly.**

S. S. I. I. p. 356.

(*Mysore Agri. Calendar 1921.*)

This insect was noticed in the State for the first time in 1919, when large areas of young jola crop (*sorghum*) were found damaged in June-July. Eggs are laid singly underneath the jola leaves. These hatch out into very small maggots which gain entry into the main





stem through the central shoot. In a very short time the plants wither and die. Pupation takes place inside the stem. Life-cycle is 17 to 18 days. The pest has a very wide distribution in the State. It is found in Bangalore, Tumkur, Mysore, Maddur, Chitaldrug, etc. The ryots have not begun to understand the seriousness of the pest. They attribute the drying up of the seedlings to the high winds and occasional dry weather after the first monsoon showers in June.

This is probably the same insect mentioned by Fletcher as the Cholum fly in his book, S. S. I. I. page 356.

The life history of the insect has been studied in Mysore. It does not appear to have been recorded elsewhere.

(4) **The Jola Earhead Gall Fly.**

Fam. Cecidomyiidae.

A very serious pest of Jola (*sorghum*) in Chamarajnagar and Nanjangud taluks of the Mysore Dt. Very large areas of jola are affected. The eggs are thrust into the unopened flowers of jola in ears. The maggots hatch out soon and begin feeding on the rich pollen of the anthers and as a result the flowers do not open out, no fertilization takes place and no grain is formed. Generally only three and sometimes 4 maggots are found for each flower and all the flowers are found infested in an ear so that not even a single grain is formed in an earhead in very bad infestation. The loss of the crop is noticed

by the cultivators only when the crop is about to mature *i.e.*, by August, but the work of destruction will have commenced early, *i.e.*, when the ears are just coming out. Infested earheads are easily made out in the early stages by the general discoloured appearance and a marked furrow or depression in the middle of all infested flowers in a head. The full grown maggots are pink and are invariably found covered up very tightly with the very thin white "palea" of the flowers. Pupation takes place inside this. Life history is not known. The pest has been noted since 1917.

Andropogon nardus, var. *coloratus*, and a species of *Panicum* are found to be the alternative host plants and these are found in plenty in and around cultivated fields.

The maggots were found to be very heavily parasitised by two species of chalcids at about the harvesting time of jola.

(5) The Cotton Flower-bud Fly.

(S. S. I. I. p. 363.)

This also belongs to the family of *Cecidomyiadae*. It was found damaging the flower buds of Cambodia cotton in a fairly large area in the Chitaldrug Dt., about the end of July 1914. The maggots developed inside the unopened flowers, the latter dropping down in large numbers and fruits were not formed. It has not been noticed as a pest since then. This is probably the same as the cotton-bud *Cecidomyiad* "*Dasyneura gossypii*", mentioned in the Second Hundred notes on Indian insects, p. 42.

(6) Silvershoots on Paddy.

(Betha Kathiru — Can.)

Pachydiplosis oryzae, Wood-mason.

Proc. Second Ent. Meeting, Pusa, p. 169.

The insect was noticed for the first time in the Mysore State in October 1920. In addition to the attack in a nursery bed, 3 to 4 acres of transplanted paddy, 3 to 4 months from transplanting, were found quite stunted and almost every shoot showing out the attack. A small chalcid parasite was found parasitising the maggots within the shoot. Thirty to forty parasitic grubs seem to be necessary to parasitise one grub — as parasitic cocoons to this number were found inside many of the shoots like an egg mass.

IV. RHYNCHOTA.

The important bug pests in the State are :—

1. *Nezara viridula*, Linn.

(S. S. I. I. p. 473.)

This is one of the commonest bugs found on cultivated plants and the ryots are familiar with it on account of the very unpleasant smell they get when the insects are disturbed during the cultivation operations. It is an occasional serious pest of wheat, coriander and horsegram in the cold season — November-January. It has a wide distribution in the State.

Control.—Collection of the bugs when they occurred as a serious pest of wheat by means of small hand nets was found effective in checking the pest to a great extent.

2. *Coptosoma cribraria*, Fb.

(S. S. I. I. p. 469.)

This has a wide distribution being chiefly found as an occasional serious pest of the lab-lab, togare (red gram) and several other vegetable crops. It is found in a number of plants throughout the year, not only on cultivated plants but also on wild plants and avenue trees like *Pongamia glabra*, etc.

3. *Anoplocnemis phasiana*, Fb.

(S. S. I. I. p. 447.)

It is found on togare (red gram) and brinjals and also on several other wild plants. In one instance it was found to damage the tender shoots of grape vines in Bangalore in the month of April. It is only a minor pest.

4. *Dysdercus cingulatus*, Fb.

(S. S. I. I. p. 484, pl. 46.)

It is found wherever cotton is grown, as an occasional serious pest occurring in January, February, March.

5. *Oxycaenus laetus*, Kby.

(S. S. I. I. p. 482.)

The insects are found wherever cotton is grown in the State. A minor pest.

6. Mango Hoppers.

(a) *Idiocerus clypealis*, Leth. (b) *Idiocerus atkinsoni*, Leth. (c) *Idiocerus niveosparsus*, Leth.

Ind. Ins. Life, p. 736.

(*Mys. Agri. Calendar* 1917, p. 10.)



Three species of hoppers are found doing serious damage to mango blossoms. The insects are very small and are found in a number of places in the State. They are found in Bangalore, Kadur, Chickmagalur, Channapatna, etc., but the insects are more numerous in Bangalore than in other places. Small, elongate, whitish eggs are laid by the insects in the tissues of mango flowers, flowerstalk and in the tender unopened leafshoots in

February-March. These hatch out into very active small insects that develop by sucking up the juice from the blossoms and tender leaves. The period from the eggs to the adults is from 7 to 10 days. There are 5 to 6 generations in the season. The major breeding season corresponds with the appearance of the mango blossoms. A very large number of these insects puncturing every available space in the flowers and sucking up the juice, make the former shrivel up and dry and no fruit is set. It is a common sight in mango gardens to see the ground underneath and the leaves and stems of mango trees shining and sticky, due to the honey dew secreted by the large number of hoppers falling on the leaves and the surface of the ground.

A very serious pest of mango causing serious loss to mango garden owners.

Control.—Spraying the trees, just before the mango blossoms open out, with fish oil resin soap, has been found to be fairly effective.

7. Aphis.

Can.—*Henu*, *Seeday*, *Karejigi*, etc.

These are very minute black insects found throughout the State. They are found both in cultivated and wild plants. Among cultivated plants a very large number are affected, viz., cotton, tobacco, cabbage, mustard, many vegetable plants, fruit trees, cucurbitaceous plants, wheat, etc., etc. This appears as a serious pest in certain years on

cotton (Dharwar American) in the month of June-July when the cotton is still young, *i.e.*, about a month or $1\frac{1}{2}$ months from sowing and on tobacco in September to December. Very large number of these insects completely cover the surface of the leaves and stems of the plants and suck the juice so that the plants look quite black and sickly and are greatly weakened.

Control.—Spraying with kerosene emulsion 1 to 70 of water or with fish oil soap 1 lb in 10 gallons of water proved very effective in killing the insects.

(To be continued.)

Prevention is better than Cure.

A LETTER TO A STOCK-OWNER.

My Dear Stock-Owner,

Yours is indeed a most noble profession, for, it has the sanction both of Religion and of Custom. It is well worth remembering that Krishna was Himself a cow-herd. But greatness always imposes certain penalties, and you are, therefore, responsible for the proper care and management of the stock you raise and rear.

I write to you the following lines for your benefit and ask you to please read, mark, learn and inwardly digest what I say. Of course you may write and ask me if you have any doubts to be cleared, for it is impossible for me to deal with Hygienic and Sanitary principles *in extenso* within the limits of this letter.

The adage, "Prevention is better than cure" remains as true to-day as it ever did, and holds quite as good in the case of animals as in that of man.

There are three main sources by which losses among the economic live-stock are daily and hourly occurring:—1. Non-contagious ailments. 2. Contagious disease, and 3. Deterioration of the various breeds. Fortunately most of these are preventible as they are due chiefly to errors of management. There are few diseases or troubles that cannot be prevented by a careful application of hygienic and sanitary principles. Even senile decay, which is inevitable, can be postponed to a surprising extent by strictly adopting hygienic principles. Adherence to these principles makes for health,

growth, efficiency and longevity ; but violation of such laws causes disease, deterioration, debility and early death.

You ask me what are these principles ? They are as follows :—

First of all good ventilation, which means free circulation of pure air, should be assured for every byre, stall or stable. Means should be adopted to secure ingress for fresh air and egress for foul air. Windows and doors situated so as to obviate a direct draught on the body of the animals, ridge, cave and ground ventilations go a long way to maintain a free circulation of pure air, an equable temperature and good light. Under such conditions the animals' power of resistance is increased, an "every day immunity" is created and many respiratory diseases, and those of the skin and blood and eye are prevented.

Next, drainage should be perfected. A flooring, which is impervious to moisture with a reasonable fall and surface drains leading out of the building with arrangement for disposal of the liquid so conducted, should suffice. All excrementitious materials should be frequently swept up, washed out and removed far from the byre, stall or stable. If you adopt this precaution your animals will feel well-housed, thrive better and will be free from diseases of the feet and skin, low fever, respiratory troubles and general debility.

A liberal supply of good wholesome water is a very important factor in the maintenance of the highest degree of health. Stagnant and impure water should be avoided as it undermines the constitution of even the strongest animal. Water contaminated by sewage conveys disease germs into the system, causes parasitic diseases of the intestines, liver and eyes, and gives rise to many diseases of the digestive and circulatory system. It is therefore, always best to ensure a good supply of pure, soft, natural water.

As with water so with food. Food should be good in quality and sufficient in quantity. To try to keep an animal on food which is innutritious is no better than starving it. To give food which is dirty, mouldy or has otherwise become bad or damaged is worse, and may induce digestive and blood troubles and abortion in pregnant animals. Food, therefore, should be clean, well-preserved and sufficiently nutritious. Please remember that "*anything*" is *not good enough for an animal to eat or drink.*

Common salt as an appetizer, alimentary antiseptic, and body-builder should necessarily enter into the daily ration. In this connection I would also particularly recommend your always having a sufficient reserve of *good* fodder for your animals.

Then again cleanliness of the skin and exercise are as essential to the health of animals as to that of men. A dirty skin makes the animal dull, unhappy and weak. It interferes with the animal's natural rest and sleep and reduces the capacity for work. Exercise or work should be neither too much nor too little. Pampering causes fatty accumulation and later on fatty degeneration. A pampered brood-animal cannot conceive, and a pregnant animal, if pampered too much will not have a safe or easy delivery. But the other extreme of over-working should also be avoided. Over-exercise or over-work fatigues the animal, brings on diseases of the lungs and heart and causes early death. Not infrequently over-work has brought on abortion in pregnant animals. By the by it is unfortunate that in our country no statistics are available of the cases of sterility and abortion—those two bugbears of the breeder in the West. I fear the figure, if correctly calculated, will be found to be *considerable* and deserving of a special campaign.

Having thus indicated the lines along which your responsibilities lie with a view to minimising losses among your live-stock from non-contagious ailments, I shall next ask you to also carefully adopt all preventive measures against infective diseases—segregation for at least 10 days of all newly purchased animals and of those returning from *Jatras* and infected areas and timely inoculation of your stock against any threatening outbreak.

After ensuring the safety of your stock from simple and general complaints and protecting them from infective and specific diseases (as and when they approach) you should turn your attention to improving the breed of your live-stock. There are two well-known methods of improving live-stock:— (1) Elimination or castration of all animals that are unfit for breeding purposes and (2) due care and attention to proper mating of superior brood animals in order to get the best offspring. Some of the important points to be carefully noted in this connection are that the would-be parents are free from hereditary diseases, that the bull, ram or other sire is of the

proper age for covering and that the respective conformations of the pair are as nearly perfect as possible.

I strongly commend the above suggestions for your guidance and trust you will do me the honour of consulting me further whenever necessary.

I remain,

Yours faithfully,

S. D. ACHAR,
Veterinary Inspector, Shimoga.

Spraying for Koleroga.

The Director of Agriculture has received the following letter signed by 27 villagers of Manjagalale village, Laxmipur Hobli, of Nagara Taluk :—

About 18 acres of areca garden were sprayed last year. We realized the good effects of this treatment and got about 175 acres of garden (in our village and two adjacent ones) sprayed during the current year. We give below the results of spraying so far as our village is concerned.

During 1920-21, wherever Kottes were tied, it was with difficulty that even a four-anna crop was saved, but where the gardens were sprayed we got an eleven-anna crop. During this year it is difficult to say that even a three-anna crop has been obtained where Kotte tying was practised. But wherever the gardens were sprayed once, a twelve-anna crop has been obtained without doubt, and where the gardens were sprayed twice, a fifteen-anna crop has been obtained. About 70 acres of areca garden have been sprayed in Manjagalale village. Even if the crop saved on account of spraying is put down at a value of Rs. 100 an acre, we have been saved on the aggregate Rs. 7,000 on account of spraying. The cost of spraying in this case was met by the Government of the Maharaja Bahadur.

The interest taken by the staff of the Agricultural Department in this connection is commendable and we have no doubt that the expenditure incurred by His Highness' Government has been amply returned.

NOTES AND COMMENTS.

We offer our sincere thanks to the outgoing Editor for the work since the starting of this Journal and hope he will continue to take interest in its welfare and contribute to its pages as usual.

* * * *

The Indian Science Congress.

The Agricultural Section of the Indian Science Congress held recently at Madras was rather a disappointment. Considering the importance of the subject, the attendance was rather too poor and the papers too few. It was being whispered here and there that an Indian Agricultural Society on the lines of the Botanical Society and as an institution affiliated to the Congress is going to be started. We wish the promoters every success and hope their efforts will be crowned with success before long.—[B.N.I.]

* * * *

Ammonium Sulphate.

Trials of sulphate of ammonia for sugarcane outside the Experimental Farms is becoming popular slowly but steadily. Mr. N. Krishna Iyengar of Urakahally Estate, our Vice-President, is himself trying it on a large scale this year and has got the manure sufficient for nearly 20 acres. We hope his example will be followed by many of our members very soon.—[B.N.I.]

* * * *

The Japanese Foot or Pedal Reeling Machine.

The Japanese Foot or Pedal Reeling Machine has evidently a great future before it in Mysore. Its introduction into Sericultural homes would free rearers from the anxiety (due to the fear of moths cutting out) which makes them sell the cocoons to the first comer at his own price. It would enable them to add the profits of reeling also to the family income. A woman can easily reel half a pound of excellent silk in a day, earning about 0-8-0 on the average. The machine is of wood, light but strong, takes but little space, and is easily worked by a pedal. The heat is supplied by a charcoal stove. In the Government Reeling School at Mysore, little girls of twelve

learnt how to operate on the machine in two months and can work on it without fatigue for six hours.

The advantages of the Foot Reeling Machine are that it is very easy to learn ; that there is great economy of fuel ; and that the silk produced is much better than that got with the ordinary reel. The reeling and turning can both be done by one person, man or woman. Miss E. Sato, the Reeling Expert says that she found it much easier to teach reeling with the foot machine than with the ordinary contrivance. There is more silk got for the same quantity of cocoons, and less waste. The cost of a machine built locally will be about Rs. 80, complete with every equipment. This is only an approximate estimate. We shall be glad to get these machines made for trial at the instance of District Boards and persons interested in the introduction and encouragement of home industries.

[N. R.]

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Silk-worms do thrive on Mulberry leaves from plants manured with Oil-cake.

There is a superstition among silk-worm rearers that silk-worms cannot thrive on mulberry leaves from plants which have been manured with oil-cake. This belief is altogether unfounded. Experience at the Channapatna Silk Farm and elsewhere proves not only that silk-worms thrive excellently on such mulberry leaves but that the cost of the oil-cake is repaid almost three-fold in increased yield. Oil-cake is used by most intelligent Sericulturists in other silk-producing countries, such as China and Japan.—[N. R.]

* * * * *

Another Superstition.

Another belief which is equally devoid of foundation is that the proximity of women in the periods peculiar to the sex is absolutely fatal to the worms. The belief probably arose in this way. Most *raiyats*, before the Government Grainages started work, lost two silk-worm crops out of five. With continuous rearings, it is very likely that some crop failures synchronized with "uncleanness" at home and it was concluded that the worms died owing to the uncleanness. It would have been just as reasonable to infer that the uncleanness was caused by the death of the worms. This foolish belief results in depriving the worms for several days of the

attention of the grown-up women of the house which is of course quite essential to the success of the rearings. It ought to be well understood that worms suffer no more inconvenience from this condition of the rearers than the rearers do from the moulting periods of the worms.—[N. R.]

* * * *

Changing Silk-worms to a Fresh Bed.

The Japanese way of changing silk-worms to a fresh bed which is now being introduced by the Sericultural Department is worthy of general adoption, at least in parts where paddy husk is easily available. This method consists in using a layer of husk in place of perforated paper or thread net. Husk is sprinkled evenly over the worms, till they are quite covered. If the worms are young, fine pounded husk may be taken, coarser stuff may be used as the rearing advances. The feed of chapped mulberry leaf is sprinkled over the husk. The worms rise through the husk on to the feed. One or two more feeds are given in due course without however repeating the husk. This results in the worms being separated from the old litter by a layer of clean yellow husk. The worms may then be swept over the husk, on which they appear in relief, to one side with a feather, and removed to another bed. This method is clean, easy, and quick.—[N. R.]

* * * *

Quality versus Quantity in Live-stock.

Some figures quoted by Dr. David S. White, the President of the American Veterinary Medical Association, in a paper read before the Wisconsin V. M. A. this year are worthy of comment.

Speaking of the United States the speaker stated that since 1867 in the rural sections milch cows have increased from 8,394,000 at \$29 each to 23,467,000 at \$79 each in 1919. Other cattle increased in the same period from 11,713,000 at \$16 each to 44,399,000 at \$45 each. Sheep from 39,385,000 at \$2.50 per head to 49,863,000 at \$12.00 per head. Swine from 24,694,000 at \$4 per head to 75,587,000 at \$22 per head.

The interesting feature in connection with the above figures is not the increased numbers in each case, although that is sufficiently striking in all classes except sheep. It is the marked increase in value in all cases that is chiefly noteworthy. Even allowing for

the general upward trend in prices, an increase of over 250 % in the case of milk cattle, nearly 300 % with other cattle, sheep 500 % and swine more than 500 % is an indication of a marked improvement in the general quality of Live-stock in the United States. It is from this aspect that such statistics should be judged and criticized. One hears much in Mysore about the necessity for an increase in the number of Live-stock in the State. Unless such an increase is accompanied by a corresponding improvement in value, little will be gained. In fact it is a matter for debate whether a decrease in numbers would not be of material benefit in clearing the way for an improvement in quality. This would obviate the necessity of caring for large numbers of cattle which are productive of nothing but a small quantity of manure and more animals of their own kind, which serve no other purpose and are incapable of performing any useful work. We confess to holding a brief for that point of view. It is certain that steps taken to improve the Live-stock situation in Mysore should be aimed directly at an improvement in quality, and the question of increased numbers be allowed to take care of itself until marked results in the former aim have been obtained.—[W. D.]

* * * * *

‘A Real form of Retrenchment.

We publish elsewhere in this issue an extract from the Breeder's Gazette anent the scrub bull and would like to draw the attention of our readers thereto.

The importance of the elimination of the scrub bull is hard to overestimate. The loss of money to individuals and to the State brought about by the use of such animals for breeding purposes is enormous. It is safe to estimate that of the one and a half million cows in the State, fully half of them are covered by scrub bulls. Supposing that the increased value of a calf sired by a good bull over that of scrub parentage is Rs. 15 at a year old, and on the supposition that only half the cows in the State calve each year, (and we consider this to be a fairly conservative estimate) the conclusion is that 375,000 calves are born annually which are sired by undesirable useless bulls. This indicates an annual loss of 4,625,000 rupees. But there is more of it than this. The increased value of calves of good breeding over those of what may be said to have no breeding, increases as they get older, until at a mature age there is

a difference of at least Rs. 50. This magnifies the loss to about 14 millions of rupees annually. It is not necessary to go into detailed calculations on this subject. The rough figures given above— and we reiterate our claim to conservatism— seem to be sufficient to emphasise the urgent need for attention to this matter, by all concerned.

The returns of castrations performed by the Civil Veterinary Department, from July 1921 to February 28, 1922, show a total number of 13,000. In comparison with previous years, this figure shows a commendable increase, being four times that of the last complete financial year, and reflects great credit on that Department. But it does not require great mathematical ability on the part of our readers for them to realize that 13,000 castrations do not go very far toward overcoming the evil of the scrub bull in a country where the cattle population is over 5 millions.

Figures are not available as to how many of these belong to the class at which we aim our remarks, but our observation forces upon us the fact that their name is Legion, and their numbers many times 13,000. Indeed the young and growing scrub bulls can be estimated at about 600,000.

On the other hand, 13,000 castrations for eight months do not indicate the limit of the powers of the Civil Veterinary Department. Much of the time of its members is taken up in using their powers of rhetoric and persuasion and in inducing the agricultural public to bring forward their animals for castration. This is where the members of the Experimental Union as well as the rest of the general public can render assistance, in advancing the propaganda of this move and in assisting to educate public opinion in its favour. Our own view of the situation is that the man who deliberately owns a scrub bull and allows it to breed should be regarded as a greater menace to advancement and a bigger moral offender than one who keeps one or more illegitimate wives.

We therefore exhort our readers to use all the power at their disposal to bring about a changed public attitude with regard to the scrub bull and to make grand and sustained endeavour to assist in bringing about the elimination of scrub cattle and the general use of good bulls.

Castrate the scrub bulls, discard the weedy heifers and breed from good bulls.—[W. D.]

Our Query Column.

Q.—In the Kolar District there are about 12-16 milk dairies. Of late, almost all of them are being closed down one after another being unable to find sale for their skim milk for curds. I request you to kindly inform me, through the columns of our Journal in the interests of the Dairy industry of the District, any commercial method for making use of the skimmed milk. The preparation of casein by the sulphuric acid method was tried but the product could find no sale.—[D.B.S.]

A.—There is an opening for the use of sour skim milk in fattening poultry. This is a matter the investigation of which I have had under contemplation for some months, but have not so far initiated.

Of course the use of skim milk for feeding calves is the proper one and even skim milk curds should be feasible for human consumption.

As far as I have been able to make out, the trouble is not a lack of uses to which the skim milk can be put, but a lack of initiative on the part of the producers to encourage a market. This is a subject which calls for a special organization which is hardly likely to be forthcoming at the present moment.—[W. D.]

SELECTIONS.

I

The Scrub Bull.

For the ten thousandth time we reiterate; few farmers are rich enough to afford the luxury of scrubs around their places. The presence of a miserably inferior type of live-stock is a reproach to the intelligence of the owner and to his neighbourhood. It is so easy to get rid of them, so easy to banish them by the use of a registered sire, that it is one of the mysteries of the times in which we live that a clear majority of American Farmers are to-day apparently satisfied with "scrub" stock and "scrub" farm papers as well; the two things of course going naturally together.—*Breeder's Gazette*, Jan. 1922.

II

Yield of Sisal Fibre in Jamaica.

The average annual yield of sisal fibre in East Africa, the Bahamas and other countries, is about one to one and a half tons per acre. The following figures, issued by the Director of Agriculture, Jamaica, and published in the *Journal of the Jamaica Agricultural Society*, indicate that the yields obtained at Lititz are somewhat below the average, though there must be taken into account the fact that the soil at Lititz is of the poorest character, subject to very dry climatic conditions:—

	Cut, November 1919	Cut, November 1920
Average number of leaves fit to be cut per plant	32	30
Average yield of leaves in lbs. per plant	19	18
Average weight of single leaf	9.6 oz.	9.7 oz.
Recovery of fibre (by hand) per cent	3.4	3.93
Fibre per 1,000 plants in lbs. ..	646	759
Yield per acre of fibre at normal distance of 6 x 5	938	1,029
Total ..	2 cuttings 1,967	

These results are encouraging, as the drought at Lititz in 1920 has been very severe, and the experiment site is considered to be the most infertile area on the whole of the Lititz Savannah.

While the leaves average slightly more in weight than last year, the percentage of fibre has increased from 3.4 to 3.93, and the gross return

of fibre is now indicated to be at the rate of 1,079 lbs. of fibre per acre, as against 938 lbs. per acre for 1919, for the first crop.

In less than a year we have thus obtained from this test area 1,967 lbs. of fibre per acre, worth about £40 in London to-day. We should get four crops before the plants are exhausted, so as to get about 4,000 lbs. of fibre per acre before replanting becomes necessary.

It is therefore evident that the growing of sisal for fibre at Lititz should be a profitable undertaking.—*Agricultural News*, Vol. XX, No. 494.

III

Milk Production of Young Cows compared with that of Mature Cows.

The question is often asked as to how much more milk will a mature cow yield than a two-year-old cow with her first calf. In other words if a heifer produces 6,700 pounds of milk and 360 pounds of butter during her first year's milking, how much will she yield as a mature cow, and at what age will she produce the largest quantity?

To determine this matter I studied the yearly official test records of 1865 Jersey cows; so my work relates only to that breed, although it holds good in a general way for all dairy breeds.

The records are as follows:—

Production of young cows compared with that of mature cows.

Age of cow	Number of cows	Milk	Per cent	Butter Fat	Per cent
Year		Pounds		Pounds	
1	86	6,267	68	337	71
2	278	6,707	74	359	73
3	126	7,496	82	399	81
4	112	8,231	91	449	92
5	91	8,222	91	441	92
6	60	8,490	94	460	96
7	47	9,029	100	477	100
8	29	8,755	97	462	97
9	25	8,718	97	476	100
10	11	8,887	98	464	97

From the above table it is found that a heifer that produces 6,700 pounds of milk and 360 pounds of butter fat as a two-year-old will yield 9,000 pounds milk, and 480 pounds butter fat as a mature cow, at seven

years of age. But she becomes over 90 per cent as efficient at four years old, or practically mature with the third calf. And apparently the cow will hold her maximum efficiency through her tenth year.

We find also from this table that young cows gain an easier entrance into the Register of Merit than old cows, and the same is true with all dairy breeds. To prove this statement we will call attention to the fact that six-year-old cows exceed two-year-old cows by 101 pounds fat, or by 23 per cent, while the standard for entrance into the efficiency test book has a difference between these ages of 110 pounds (250 pounds for two-year-old and 360 for five-year and over) or 30 per cent. To state it differently a two-year-old excels her requirement by 39 per cent, and the six-year-old one excels hers by only 22 per cent. But the error is not a serious one.—*Journal of Dairy Science, Volume IV, No. 5.*

IV

How to select Desirable Ears of Corn for Seed purposes.

There are two distinct steps in corn selection. One is to select the most desirable ears, using neither measurement nor score card. The other is to take the ears first selected and judge each one very carefully, noting on a previously prepared score card the value of each character. The first step, which consists simply in picking out the most desirable ears from the crop after it is harvested, does not require much time, but it is one which no farmer can afford to neglect. At the same time these questions should be kept in mind: Will it germinate? Is it pure, that is, will the kernels when planted produce ears of the same size, shape, colour, etc.? Is it the shape desirable? How much will it yield? The following directions will be helpful in determining the approximate value of an ear by looking at it:

Will it germinate? If in doubt, test it. Look for:—

Mouldiness:—Discard all ears that are the least bit mouldy or that look as if they will not dry out without becoming mouldy.

Ripeness:—Discard all ears on which the kernels are very wrinkled, dull in colour, or discoloured.

Insect injury:—The principal dangerous insect is the weevil. A few weevil burrows may not cause much damage, but if corn is much weevil eaten, the germination will be impaired.

Is it pure? Look for:—

Uniformity of kernels:—Discard all ears having kernels of different colour; also all ears having many small or undeveloped kernels, or, in general, kernels of different size.

Colour of cob :—The cob should be of the same colour as the grain, unless difference in colour is known to be a variety character.

Is the shape desirable? Look for :—

Straightness of rows :—Discard all ears on which many of the kernels are irregularly arranged : also ears on which the rows are very crooked.

Butt :—The butt should preferably be covered with kernels to the extent that a cavity is left after the ear is broken off the stalk. The kernels should retain their size and shape well toward the butt.

Tip :—The tip should preferably be entirely covered with kernels. The circumference of a short ear, measured 1 to 2 inches from the butt and one inch from the tip, should not differ more than $1\frac{1}{2}$ inches between the points measured. The pointed ear has too many irregular-shaped kernels at the tip, resulting in low yields.

How much will it yield? Look for :—

Length of ear :—Discard all ears less than 7 inches long. If there are enough desirable ears over 8 inches, discard all the shorter ones.

Circumference of ear :—An ear 7 to $7\frac{1}{2}$ inches long should be at least $6\frac{1}{4}$ inches in circumference, but not more than 7 inches. An ear 8 to 9 inches long should be at least $6\frac{1}{2}$ inches in circumference, and a length of 9 inches and up calls for a circumference of 7 inches and up.

Depth, shape, and space of kernels :—Deep rectangular kernels, placed so close together that they cannot readily be moved by passing the fingers over them, are sure signs of high yield.

Weight of grain :—Fifty average well-shaped kernels will weigh about 1 ounce. An ear containing fourteen rows with forty well-shaped kernels in each row, will have 560 kernels. This would be at least 11 ounces of grain for planting. The irregular-shaped kernels at butt and tip should not be planted.—*The Agricultural News*, Volume XX, No. 494.

V

India's Awakening.

The force of necessity is irresistible.—*Aeschylus*.

Agricultural engineers who are justifiably perturbed at the loss, temporary we hope, of certain Continental markets will do well to keep an eye upon the changing situation in India. Time and again have we, through the medium of valued correspondents and other sources, obtained information which shows that our houses will have to be particularly watchful of their trade elsewhere, otherwise very alert rivals will leave them standing. We know that much has been done to improve our

thrasher trade out East to give us a good hold of the slowly growing sales for tractors, and to cultivate more intimately the inquiry for harvesting implements. India in the past has been a limited field, the restrictions being defined by the plentiful supply of cheap labour and by the further fact that the same element, being untutored, has confined the scope for machinery requiring intelligent handling. But it would be folly for our manufacturers to live in the past. Evidence accumulates to show that there is a new spirit prevailing in the East. The old-fashioned country-made ploughs, the *kunte* or native hoe, and similar tools are no longer good enough for the progressive agriculturist. A writer in the Journal of the Mysore Agricultural and Experimental Union puts the reason very succinctly when he points out that on the dry light soils a ryot (a peasant cultivator) can cultivate five acres with a pair of bullocks and an old country plough, but with a modern implement he can cultivate from eight to ten acres. That this fact has been extensively realized by Indian agriculturists themselves is significant. Equally to the point is the attention being devoted, *vide* the Journal of the Union, to anything mechanical. Pumping outfits for irrigation work, driven by oil engines of British manufacture, are supervised by the village "Thoti" and worked by the ryots, and the new ploughs of modern design are being sought because they have proved to be so greatly superior to the old-fashioned types. A Glasgow-made power mill is used in one case to crush sugarcane down into jaggery, and a thrasher, which cost Rupees 650, is requisitioned to thrash the ragi crop which is grown in rotation and after the sugar on the same farm. Of value, indeed, is the owners' statement that without his modern plant he would not be able to keep time with the cycle of operations, and it has created a profound impression among Indian agriculturists. There seems to be a great awakening out East, and we may rely upon British manufacturers, to grasp the substance thereby offered, rather than clinging to the shadow of markets from which force of circumstances dictates a temporary, partial or complete exclusion. India seems to be very rich in promise.— *The Implement and Machinery Review*, Volume 47, No. 558.

VI

Rust or Leaf Disease. (*Hemileia vastatrix*)

This is the most serious fungoid disease of coffee found in this country. If allowed to go unchecked it is capable of defoliating a plantation, while any considerable attack represents a loss of proportion of food which the leaves would normally manufacture and which should be employed in

the further development of the bushes and in the formation of the coffee bean.

In Ceylon during the latter part of the last century, the ravages of Leaf Diseases caused the abandonment of the coffee planting industry. While it is not thought likely, with our better knowledge of the disease and under the different conditions prevailing in this country, that the disease would cause such havoc here, it still behoves coffee growers to regard it with respect and to keep a watchful eye for its appearance.

The disease is usually first detected by the appearance of orange yellow spots on the lower sides of the leaves. These spots which are very small when first visible, may enlarge to about half an inch in diameter. The orange yellow powder of the spots consists of vast number of the spores of the fungus, each of which is capable when mature of causing a fresh infection. No spores are produced on the upper surface of the leaves but when the spots below have become fairly large, pale areas are noticeable above corresponding with the spots below. The centres of the latter as they get older become brown or grey. A severe attack on a leaf may cause it to dry up and turn brown.

Infection is produced by the germination of a spore on the underside of the leaf. The spore sends out a fine tube which gains access to the interior of the leaf through one of the numerous breathing pores. Once inside, the tube grows between the cells and forms numerous branches, the whole fungus body being known as the mycelium. This mycelium develops suckers which it intrudes into the cells for the purpose of absorbing the cell contents. After a time, a part of the mycelium masses in one of the air-spaces beneath a breathing pore and sends out short pedicels through the pore. From the ends of these pedicels the spores are formed. These are at first colourless but on maturing, the contents of each spore become orange-yellow, thus producing the characteristic colour of the spots.

While it is true that the best kept *shambas* are sometimes invaded by the Leaf Disease, severe attacks in this country are commonly found to be connected with neglect. Weeds are a great source of danger. Not only do they impoverish the ground to a certain extent but they harbour spores of the fungus and, in bad cases, interfere with the ventilation between the bushes and tend to create a damp atmosphere favourable to the activities of the fungus.

A proper system of pruning should be carried out to promote a healthy growth of the bushes.

Diseased leaves should not be left lying about between the bushes.

Hemileia vastatrix is known to continue spore production on affected leaves for some days after the leaves have fallen. The leaves should be dug under or burned, preferably the former, as by this method organic material is returned to the soil.

It is a matter of common observation that the first leaves of a bush to be attacked are frequently those which are allowed to hang down close to the ground. Fallen spores splashed up by rain easily reach such branches, which should, therefore, be cut off.

Spraying trials in this country have shown that certain fungicides may be used with success as preventive measures against Leaf Disease. Details of three such sprays are given in a pamphlet issued by the Department of Agriculture, entitled "Three Sprays for Coffee affected with *Hemileia Vastatrix* and other Fungus Diseases". Further spray trials are at present in progress and should these prove successful details of them will be published later.

Spraying undoubtedly entails a certain amount of trouble and expense not only in labour, but also in the purchase of the necessary chemicals. It is not, therefore, suggested that spraying the whole of a large shamba should be done every season. It is urged, however, that spraying done at certain times is highly beneficial and well repays trouble and expense. For example, in localities where conditions are favourable to the fungus (such as in the lower parts of the Highlands in wet season), where signs of the disease have been noticed during the previous season or where the bushes are known to have been weakened from any cause, spraying should be carried out.

In spraying against Leaf Disease it is important to ensure that the undersides of the leaves are thoroughly wetted. The finest nozzle obtainable should be used.

A good plan is to spray once shortly before the rains usually commence and again when the young leaves have expanded somewhat. If the second spraying is neglected, the area of new surface exposed by the development of the new leaves will be unprotected by the fungicide.

It has been found in other parts of the world that heavy applications of farmyard manure ($\frac{1}{2}$ cwt. per tree) have been successful in controlling the disease.—From a leaflet on "*Fungoid Diseases of Coffee in Kenya Colony*" of the Department of Agriculture, B. E. A.

***Striga* as a Root Parasite of Sugarcane. ***

In September 1920, when the writer was checking the cotton survey in Samrala Tehsil of the Ludhiana District, reports were received of the occurrence of a serious pest in the sugarcane fields of the "Bet" lands of the river Sutlej. On examining the affected canes, it was noticed that they were badly attacked by the parasitic plants of the genus *Striga*, natural order Scrophulariaceæ. Two distinct species were found and they have since been identified as *Striga densiflora* Benth. and *S. euphrasioides* Benth. They arise from the bases of the canes in large numbers and hundreds of these were found together at one place (Plate I, fig. 1). They appear in clusters even at some distance from the canes but they have underground connections with them at the roots (Plate I, fig. 2). The two species were met with in different fields. *S. densiflora* occurs in the villages of Shergarh, Fatehgarh, Makowal, etc., and *S. euphrasioides* has been found in the canes and jowar (*Andropogon Sorghum*) fields of Pawat village.

Bet lands are low but beyond the reach of the flood water and are very suitable for cane cultivation. The variety of cane grown is *katha* and is mainly cultivated within the first twelve or fifteen miles of the Bet. Sugarcane is an important crop in this tract but in some fields it has been ruinously damaged by the parasite. Many patches are seen in the fields where the canes have been killed by the pest.

The parasite is said to have been first noticed about seven years ago in the village Garhi which lies in the Patiala State territory. In Sherpur and Fatehgarh it has been seen now for three years.

The canes attacked by the parasite remain stunted, their leaves wither and have the appearance of a drought-stricken plant. Some of the canes are totally killed by association of the parasite, while others have evidently withstood the attack and are affected very little (Plate I, figs. 1 and 2).

It remains to find out how the parasite injures the cane. Several opinions are on record with regard to this problem. There is no mention however, of any observations having been made on the parasitism of *Striga*. Both *S. densiflora* and *S. euphrasioides* are known as root parasites and as such they attach themselves by their roots to the roots of the sugarcane (Plate II). They suck the sap from the host which being deprived of its nutrition, suffers from starvation and ultimately

* We are indebted to the Agricultural Adviser to the Government of India for the loan of blocks in this article.—ED.

dies. In the "Dictionary of the Economic Products of India" by George Watt it is mentioned that "although no Indian writer has especially noted the direct attachment of the *Striga* weed to the roots of *Sorghum* or *Saccharum*, yet there is little doubt that it is in that way that the weed effects its destructive mission." In another place in the same book it is stated that the pest only appears when the land has been exhausted by overcultivation. The exhaustion theory is refuted easily by the fact that as *Striga* appears in cane fields it must have some affinity and connection with this crop and not with soil alone. Similarly, doubt is entertained regarding the parasitic nature of *Striga lutea* which grows on the roots of *jowar*, though it is proved that "if *jowar* is grown for a number of years successively the parasite continues to appear, and if cotton is planted on the same field it disappears."

The investigations dealt with here have been only recently started and good deal of work has yet to be done, but the few observations so far made will enlighten us on the parasitism of *Striga* and its relationship with the roots of sugarcane.

In the Samrala Bet, sugarcane is sown in April-May and the parasite comes out in July-August. Many offshoots are given off from the underground portion of the stem of the parasite (Plate II, fig. 4). These offshoots pierce through the ground and come up. Cracks are seen in the soil where the new shoots are making their way upwards. From 15 to 30 offshoots have been counted on one plant of *Striga*. Fresh offshoots continue to arise till September-October. By this time older offshoots produce flowers and seed is formed. *Striga* comes to maturity in December and both the aerial as well as the underground parts altogether dry up. The seed is very minute and light. It is produced in large quantities in small capsules which burst longitudinally when dry and let the seeds go out.

There are 50 to 70 capsules on the shoot. A seed measures 0.3 mm. in length and 0.1 mm. in breadth. Myriads of these tiny seeds are liberated from the capsules and fall on the field after the parasite has matured. The seed of the parasite remains in the soil and germinates if sugarcane is grown there in the next season. The parasite reproduces from seed and vegetative reproduction does not occur. Every part of it dies when its season is over. Generally the seeds of such parasites germinate at the time when the proper host is growing near by. The sowing of cane in fields already infected with the seed of the parasite would supply the necessary stimulus for its growth. In the case of *Orobanche indica* it has been found that its seeds do not germinate until tobacco or mustard or petunia is grown with it.



Fig. 4.

(a), off-shoots . (b), a rootlet of sugarcane ; (c), a rootlet of *Striga* ; (d), haustoria.

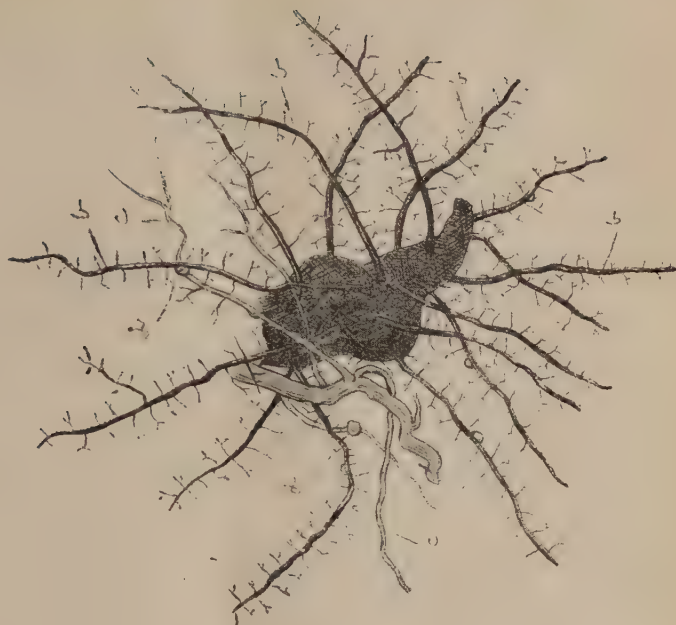


Fig. 5.

The characters of the two species of *Striga* are almost the same as those described by Hooker. Difference, however, is found in the height of *S. densiflora* which grows to a height of 30 inches against 18 inches as mentioned by Hooker. Leaves are small and green. Flowers are white, but they turn bluish when dry. The whole plant becomes black in dry condition. The cause of the wilting of the sugarcane in these cases lies in the root. If a cane and parasite situated near it are dug out by the roots, it is found that the roots of both are mixed up in a tangled mass, but the roots of *Striga* are white and those of the cane are black and they can thus be differentiated from each other (Plates II and III). Roots of *Striga* branch extensively forming a network of fine rootlets which closely infest the rootlets of the affected cane. The roots of the parasite bear a large number of white spherical nodules called haustoria (Plates II and III). In some places they are present in rows. The haustoria are often found united with the rootlets of canes (Plate II). By means of these haustoria the parasite secures its connection with the host and draws nourishment from it. Haustoria either arise freely from the parasite's rootlets or may become fastened on the roots of the host. They vary in size from one millimetre to three millimetres. Some of the haustoria send out thread-like processes. In one instance, two haustoria borne on adjacent rootlets of *Striga* have been found united. Rootlets of *Striga* bear root hairs also (Plate III, fig. 9). The root hairs are comparatively few and are poorly developed.

The structure of the haustorium has been studied in a number of sections cut at various places. A free haustorium is made up of parenchymatous cells. The central region looks darker than the peripheral portion. The outer cells contain starch grains, and the cells in the centre appear to be full of protoplasm. The portion of the haustorium next to the parasite's root contains reticulately thickened xylem vessels. These vessels are connected with similar vessels in the parasite's rootlet. Probably nutriment for the haustorium is supplied through the vessels.

The haustorium on attacking the rootlet of cane brings about several changes in itself as well as in the host's root. In order to understand these changes we should first study the structure of the root of sugarcane.

A transverse section of its roots shows the epiblema on the outside where root hairs are also seen. There is very little of cortical tissue. Almost the whole of the cortex is occupied by air cavities which are separated from one another by strands of tissue. The endodermis is well developed and its radial and inner walls are much thickened. The

vascular tissue consists of xylem and phloem bundles which vary in number and enclose a pith. The presence of large air cavities shows that the roots of sugarcane are adapted to aquatic conditions.

The haustorium, when it invades a rootlet of cane, easily breaks through the cortex and comes to lie against the endodermis. The walls of the latter being strong and cutinised are not injured by the haustorium. At this point a process called the sucker develops from the haustorium and grows inwards. It ultimately ruptures the endodermis and penetrates into the vascular tissue. In the sections passing through this portion of the attacked root the sucker can be traced right into the xylem. The reticulate vessels which extended up to the middle in a free haustorium are formed in the whole of it, as well as are seen in the sucker. There is thus a continuous vascular tissue running through the parasite's root, the haustorium and the root of the cane, to conduct away the fluids from the host to the parasite.

Striga has green leaves which contain mesophyll tissue and chloroplasts. Being thus provided with the necessary means for carrying on anabolic processes it can elaborate its own food. While parasitizing on the host's roots *Striga* plants must be absorbing food materials from the soils by its root hairs. The *Striga* therefore comes in the category of semi-parasites. The existence of a few such parasites would not do much damage to the host, but as it occurs in thousands in a cane field the cumulative effect is very harmful. In the villages mentioned above it is prevailing to an alarming extent and unless preventive measures are adopted to check its progress it will spread to those areas where it is not present now.

As regards measures for its eradication nothing definite can be said at this stage of the study of the subject. But from our experience of other flowering parasites, viz., *Orobancha*,* it can be safely stated that the weeding out of the parasite by hand from time to time before its shoots flower would be very helpful in keeping it down. The parasite being removed before its seeds are formed the soil will not thus get fresh infection from the seed.

Cotton is not susceptible to the attack of the parasite and wherever possible its cultivation should be encouraged in place of sugarcane in the affected areas.—*The Agricultural Journal of India*, Vol. XVI., Pt. V.

* Shaw, F. J. F. *Orobancha* as a Parasite in Behar. *Mem. Dept. Agri. India, Bot. Ser.*, IX, No. 3.

Plate III.—*STRIGA* AS A ROOT PARASITE OF SUGARCANE.



Fig. 6.



Fig. 7.



Fig. 8.

A rootlet of *Striga* bearing a haustorium.



Fig. 9.

A part of a rootlet of *Striga* with root hairs (e).

VIII

Drainage and its relation to Crop Production.

The greatest economic problem with which the world is faced to-day is the problem of greater food production, both for man and beast. It is, therefore, the duty of every man within whose power it lies, to assist in any way in this greater production, to throw the full weight of his influence as well as his physical energy into the work to be carried on. To the farmer, it means not only an increased number of hours of labour, but also a more intelligent handling of the problem of crop production and also soil improvement while the crops are taking from the fields the natural plant food in the soil. It is his duty, therefore, to give back to the land at least as much plant food in available form as is taken from it each season by leaching, or in the form of grain, straw or root crop. The amount of plant food in the barnyard manure on the average farm, combined with the plant food obtained by the use of leguminous plants, is not sufficient to accomplish the desired result of greater crop production, combined with better soil fertility: and, therefore, it is necessary for practically every farmer to supplement his available supply of fertilizer produced on the farm with commercial fertilizers.

The problem of soil fertility and the relation of drainage to crop production may be approached thus: Given a field not producing the crop which it should produce, where shall we begin to analyze conditions of partial or complete crop failure. Go to the root of the matter and discuss the sub-soil conditions first of all. Unless gravitational water is free to pass down at least to where it will not interfere with root development, it will prove a dry, infertile business. analyzing soil conditions if the regulation of water supply is not first considered.

WHY DRAINAGE NECESSARY?

The following statements, though not proved beyond a possibility of doubt, contain the best available information in concentrated form regarding the effects of drainage on efficiency of crop production. Viewed in the light of experimental facts on which these statements are based, they contain sufficient truth to warrant their being used as a basis on which to act when serious consideration of greater crop production is the problem crying for solution. The statements are as follows:—

1. Soils fail to produce crops oftener on account of poor physical condition of the soil than on account of poor chemical composition.
2. Temporary wetness on cultivated lands is more injurious than permanent wetness in swamp areas.
3. Fertilizers give greatest efficiency on properly drained lands.

4. Drainage reduces the "net loss" of plant food in the soil on which crops are being grown.

5. Drainage lessens the "immediate" need of fertilizers.

A knowledge of these statements "properly interpreted" and acted upon, will add materially to the efficiency of farm labour, and the use of fertilizers in any or all forms; and result in both greater production and better soil fertility. Referring to number 5 above, it may be stated that drainage cannot and is not intended to "build up" fertility of the soil. It simply makes the supply of plant food in the soil more available and aids, therefore, in the immediate temporary solution of our "world shortage of food" problem, as the supply of commercial fertilizer is limited. All the fertilizer that can possibly be produced at present should be added to Canadian soils, and the efficiency of this fertilizer in every case will be increased by the previous operation of drainage (see statement 3 above).

A word may be said in explanation of statement 2 above. By swamp lands, which compose a small percentage of the total tillable land surface of Canada, we mean swamp land on which no effort is made to grow crops. Poorly drained tilled land hard to work, wastes energy in the form of labour; cultivation is carried on at the wrong period: good seed is prevented from producing its kind: fertilizers added cannot be acted upon by the soil organisms to produce the available plant food, and the net loss is enormous. Numbers 1 and 3 above are facts requiring no account of leaching through drainage, it is still a scientific fact that proper drainage of a soil results in greater crop production with less "net loss" of plant food elements in the soil.

A short detailed description of the various factors in plant growth, the efficiency of which is increased by proper drainage, will not be amiss. These factors in the life of the plant may be listed as follows: (1) Moisture; (2) heat; (3) air; (4) plant food. A more or less thorough understanding of how the increased efficiency of these is brought about by drainage is necessary if the problem of greater food production and soil improvement are to be carried on simultaneously.

The water in the soil must be first regulated or the analysis of conditions preventing maximum crop growth will prove a more or less infertile business. Water used by the plant is, in the main, used in the form of capillary water, meaning that water which clings in a thin film to the soil grains, and as the plant takes in this moisture in the immediate vicinity of the roots, the film, as it were, crawls from where the layer of moisture is thickest towards the places where the moisture is being used up by the plant. The object in soil drainage or cultivation is to

retain as much water as possible in this film state, leave it as free as possible to circulate, and thus keep the plant at all times supplied. The free passage of gravitational water or water in bulk form, which by its weight is caused to pass downward through the soil, is much to be desired, as it leaves in its wake moist soil (not saturated), in which greater and deeper root development takes place. These deeper roots would not be allowed to form if the water has not so far to rise by capillary action from the wetter soil beneath before it can give the required amount of moisture for plant growth. Thus drainage adds to the "optimum" amount of soil moisture in wet or dry weather.

Soils in which plants grow to best advantage must be warm soils. The presence of water in quantities larger than are necessary for plant growth causes the soil to be colder than it otherwise would be, as these quantities of water must have their temperature raised and absorb useful heat while no advantage from this is gained by the soil. Water, moreover, is about five times as difficult to heat as ordinary soil which adds to the quantity of heat wasted. If water is left near the surface of a soil, evaporation takes place in excessive amounts which may reduce the temperature of the soil as much as five degrees, if under certain weather conditions. Again available plant food is produced in greater quantities in the warmer soil on account of the greater activity of soil organisms.

FUNCTION OF AIR IN SOIL.

The quantity of air in well-drained soil is much larger than in under-drained, because of the absence of gravitational water, and also on account of increased pore space due to better soil structure. This increase of air enables the soil bacteria to change the more available plant food in the soil into available, and thus increases the efficiency of the soil constituents, as well as the efficiency of plant food supplied to the soil in the form of fertilizers, which have to be chemically and bacteriologically acted upon before becoming available for plant food. Not only is aeration made possible, but ventilation is increased, due to changes in temperature in the soil and also the downward movement of capillary water which allows the air to follow in its wake.

Where roots are permitted to develop deeper in the soil, they are permitted to go farther in their search for plant food and make this food supply more abundant. They cause cleavages in the soil which tend to reduce the putty-like nature of clay soils. These roots, when they decay, form vegetable matter on which the next year's plant may feed, after this vegetable matter has been acted upon by soil organisms to reduce it to plant food form.—*The Canadian Countryman*, Vol. IX, No. 39

**The Cultivation of Sugarcane in Java as recorded by the Indian
Sugar Committee.**

(Continued from our last issue.)

METHOD OF CULTIVATION.

(a) *Supply of sets.*—One of the most striking features of the work of the Java plantations is the careful attention given to the supply of sets for planting new cane. The planters have still a lively recollection of the havoc wrought by the *serch* disease and now do all in their power to ensure that only sound and vigorous sets are used for planting. Their material is derived from three sources. Hill sets (*berg bibits*) are immature canes of six to ten months growth which have been grown in nurseries on the hills at altitudes varying from 1,000 to 3,000 ft. These are taken either direct to the factory fields or to plantations in the plains for the growth of plains sets (*vlakte bibits*). The plains sets are, like the hill sets, derived from immature canes six months old, but are grown in plantations at lower altitudes and nearer the factory lands when not actually grown on the latter. All the hill nurseries and some of those in the plains are devoted entirely to the production of sets for sale. The third source of supply is the tops of ripe canes which have been cut for milling in the factory. Many factories have nurseries of their own from which they supplement the supply obtained from those devoted solely to raising seed. Plains sets are treated in two ways. Either the whole is cut after six months growth and used for planting, each young cane producing at least two but more generally three sets, or the top only is cut off to provide one set. The rest of the cane is then left standing for a period of 10 to 45 days when the whole is cut for sowing, each set being cut so as to consist of one or two young shoots, the leaves of which are cut and trimmed to prevent the set drying by transpiration before the roots develop. Such sets are known as *rajoengans*. When they consist of one shoot only they are from 35 to 45 days old and are planted upright. Two shoot *rajoengans*, which are, as a rule, younger are planted in a sloping position with the cane completely covered but with the ends of both shoots well above the ground. *Rajoengans* are generally used for the middle and later sowings and give as good a crop as when other sets are used. This method is followed only by factories which have nurseries of their own, owing to the difficulty in transporting sets of this kind.

It will be understood that it is an expensive matter to plant large areas of cane on factory lands with sets brought long distances from

the hill nurseries. Whilst, therefore, some of the new cane on factory land is always planted with sets from hill nurseries, the tendency of late in some districts has been to rely less on the latter and to plant larger areas of cane from sets obtained from the nearer nurseries which have themselves used hill sets. This tendency is especially marked in the Djokjakarta tract which is favourably situated climatically and where only 4 per cent of the area under cane is now sown with seed from hill nurseries against 66 per cent from plains nurseries and 30 per cent from tops of cane milled in the factory. In the remainder of Java the corresponding proportions in 1918 were 35, 31 and 34. The quantity of sets required to plant one bouw of new cane is about $3\frac{1}{2}$ to $4\frac{1}{2}$ tons, and in 1919 the cost of sets from hill nurseries amounted to 90 guilders per bouw (that is, 51 rupees per acre) against 40 guilders (or 23 rupees per acre) for sets from those in the plains. It is thus a very heavy item in expenditure and one that appears likely to increase. The cane from which sets are obtained is planted in November and December. It is cut at the sowing season in June and July when it is six months old. As one bouw of seed cane may give in six months sets for eight bouws of new cane which can be sown at once and in another six months give sets for 64 bouws, it will be seen that after two years sets of any new variety it is desired to extend are available for 4,096 bouws. The speed with which new and better varieties of cane have replaced old ones during recent years in Java is thus accounted for, though it is not quite so rapid as the above figures would indicate, as, when a promising cane has been evolved, it has first to be propagated and tested at the Research Station for sucrose content and purity of juice and its ripening period ascertained, which takes three years. At the end of that period small parcels are sent out to factories with the request that the cane should be multiplied. In the case of very promising varieties these parcels are sometimes sent after two years. In the event of the tests at the Research Station turning out well a supply of sets is in hand for further work. We were informed that five years are the minimum required to establish a good new cane over five to six thousand bouws.

(b) *Preparation of sets for planting.*—Before passing on to the subject of varieties a word should be said regarding the preparation for planting of the tops of the ripe canes used for milling in the factories. These are collected in the fields when the canes are cut and are taken to sheds which are often of a permanent character. If a permanent shed is not available, a temporary thatched shed is erected near the field for which the cane is to be used. In this the leaves are carefully removed and the buds inspected, tops with injured or faulty buds being rejected.

The sound tops each of which forms one set are then cut at both ends so as to leave three or at the most four healthy buds. The sets thus prepared are taken in baskets to the fields and planted. In one instance we noticed that the ends of the sets were dipped in tar before planting as a protection against pests. It is, however, more usual to dip the baskets of sets in Bordeaux mixture.

(c) *Varieties*.—The varieties of cane grown in Java have undergone much change during recent years. The earlier Chunni crosses made by Dr Kobus and his co-workers, which were so successful owing to their almost complete resistance to sereh, have almost disappeared. Whilst resistance to sereh is as important a quality as ever, the intensive methods of cultivation have made it imperative that heavy yielding varieties should be grown. As we have already stated, in addition to the work which is done at Pasoeroean, many factory managers and owners of nurseries have taken up with enthusiasm the work of producing and selecting new seedling canes and have achieved remarkable success. In fact, most of the varieties we saw on factory land during our visit were selections from crosses made by factory managers and planters.

New canes are subjected to very thorough tests by the staff of the department at Pasoeroean, and, if any cane shows undoubted superiority, it is recommended whatever its origin may be. The rapidity with which the variety EK. 28, which was produced by a factory manager, Mr. Emil Karthaus, has spread in the Djokjakarta tract, where in 1920, 50 per cent of the total area of cane was under this variety as against 2 per cent in 1915, shows that no time is lost by planters in taking up a new cane which is found suitable for a particular tract.

(d) *Field methods*.—The excellence of the methods of cultivation in use on cane lands in Java has long been recognized. The trench system known as the Reynoso system is in general use on all factory lands. Cultivation is still carried out almost entirely by hand labour and little progress has been made up to the present in the adoption of mechanical methods. Almost the only crop rotated with cane is rice, and the land is taken over from the cultivators immediately after the rice crop has been harvested in April and May. The first step taken is to construct drains. These are of two kinds, deep drains two feet wide and $1\frac{1}{2}$ to 2 feet deep and shallow drains 1 foot wide and 1 foot to $1\frac{1}{2}$ feet deep. The shallow drains run into the deeper ones. Where the land has exceptionally good natural drainage, the deeper drains are dispensed with. On such lands the shallow drains are made 30 feet apart, but when used in conjunction with deeper drains on land with poor natural drainage they are sometimes closer and may even be only 12 to 15 feet apart. The

larger drains are 120 feet apart. This procedure results in a highly efficient system of drainage, and without it it would not be possible to grow cane on much of the land in Java. A prominent feature of the cane cultivation is the rapidity with which land is prepared for cane planting. The structure of the soils is such that they do not pack and dry into a hard mass when worked wet as happens with the soil of the Gangetic plain; and no harm, therefore, results from working wet land. Immediately after the construction of the drains is completed, the making of the trenches is begun. These are made between the smaller drains and are thus 12 to 30 feet long. The standard dimensions are 4 feet from centre to centre, 1 foot in depth and a little less than 2 feet wide. After the trenches are made, the soil at the bottom is dug to a depth of six inches. The trenches are made gradually as the rice crop is removed and no preliminary ploughings are given. On an estate planting 1,600 bouws of cane, 50 per cent of the area would be prepared between April 1st and May 1st. The planting season lasts from May till October, but the best results are obtained by planting in June and July. The sets are sown some six to eight weeks after the trenches are made and, as a rule, parallel to the sides of the trenches and only a few inches apart. In some cases the sets are planted at a greater distance from each other than this and at right angles to the trenches, being placed in small holes separated from each other by little dykes. The object of this method is to save water, and it is, therefore, adopted where irrigation facilities are limited or it is desired to avoid putting too much water on heavy soils. The sets with young shoots are, as already stated, planted in a sloping position. Other sets are planted at a very shallow depth in the trenches and are often not completely covered with soil. As soon as the canes are planted, they are irrigated, the drainage channels being used as irrigation channels. The rainfall in the cane growing tracts varies considerably but almost everywhere the facilities for irrigation are limited. The water requirements of the cane crop have been very carefully worked out and cane is consequently grown with the minimum of water necessary. The early irrigations after planting are very light and water is merely splashed on the trenches which are not flooded as in India. These light waterings are repeated at intervals of a few days until the cane is established. Weeding and shallow cultivation are done as required, and as the young canes grow, the trenches are gradually filled in. The canes are always thoroughly earthed up. This is done in three operations from October to December for canes which are planted in June.

(e) *Manures*.—Sulphate of ammonia is the usual form of manure. In

some soils which are deficient in phosphorus super-phosphate is necessary, but its use is not extensive. Potash salts are not used. We were informed that the economic optimum for most Java soils as worked out at Pasoeroean was 400 pounds of sulphate of ammonia per acre, approximately 80 pounds of nitrogen. Many factories have worked out the economic optimum for themselves, and the amount of sulphate of ammonia applied to some lands is as high as 550 pounds. The manure is applied in a somewhat unusual manner, being placed in small holes in the bottom of the trenches on both sides of the young plant, and covered with soil. Two doses are generally given, three and seven weeks after planting; but, if a larger quantity than 400 pounds per acre is supplied, there are three doses, three, seven and eleven weeks after planting. In one instance we found that on dry soils of coarse structure which contained 40 per cent of coarse sand molasses was being used with good results at the rate of about 1,500 to 2,250 pounds per acre. This was said to effect a great improvement in the capacity of the soil to retain water.

(f) *Cost of production of cane.*—As the cost of production of cane in Java is a point of great importance in discussing the possibility of adopting the Java methods in India, we give below a table containing two typical sets of figures which were supplied to us in Java and also, for purposes of comparison, the costs of improved cultivation on the Government farms at Shahjahanpur in the United Provinces and Manjri in the Bombay Presidency.

	Java			India	
	(A)		(B)		Manjri Rs. per acre
	Guilders per bouw	Rs. per acre	Guilders per bouw	Rs. per acre	
Rent	90.0	51.4	90.0	51.4	80.00
Cultivation including irrigation	160.0	91.4	170.0	97.1	92.25
Manure	180.0	102.8	120.0	68.6	128.25
Sets	80.0	45.7	100.0	57.1	32.0
Cutting and Transport to factory	60.0	34.3	45.6	26.0	33.0
European supervision	15.0	8.5	15.0	8.5	15.0
Native supervision	4.0	2.3	4.0	2.3	
Total	589.0	336.4	544.6	311.0	380.5
Yield of cane	*Picolis per bouw	Maunds per acre	*Picolis per bouw	Maunds per acre	Maunds per acre
	1,200	1,133	1,139	1,075	1,069
Cost of cane in annas per maund		4.75		4.63	5.70

* 1 Picol=136 lbs.

The first set of figures of the cost of cultivation in Java given in the table above was supplied to us by a group adviser, as were also the first set of figures for yield of cane. The second set of figures for cost of cultivation was supplied by a factory manager, but the yield of cane in this case has been obtained from the statement published by the statistical section at Pasoeroean, which shows the average acreage and outturn results of 177 factories, representing 90 per cent of the area under cane for the harvest of 1918. The costs and yields of cane at Shahjahanpur and Manjri were obtained from the records of the Sugar-cane Research Stations at those places. It should be pointed out that the high cost of supervision they show is the direct consequence of their experimental objects, and under this head there is no really valid comparison.

The following statement shows the average yield of cane and sugar per acre in 1918 for the 177 factories mentioned above as calculated at Pasoeroean.

No. of factories submitting returns	Standard maunds of cane per acre	Standard maunds of sugar per acre	Percentage of standard muscovado sugar in cane	Percentage of fibre in cane
177	1,075	126.5	11.7	12.4

The figure of outturn of sugar per acre given in this statement differs from that given by Dr. Prinsen Geerlig in the issue of the *International Sugar Journal* for June 1920, which is the equivalent of 118 maunds of sugar per acre. The reason for this difference is that Dr. Prinsen Geerlig's figure is for 100 per cent sugar obtained by the factories, whereas the outturn in the statement is that of available standard muscovado *i.e.*, the amount of sugar calculated as standard muscovado which it is possible to obtain. All the results of the Java field experiments and some of the factory results are stated in this way.

X

Science and Crop Production.

The beginning of much of our scientific work on crop production goes back to the year 1843, when Lawes and Gilbert set out to discover why farmyard manure is such an excellent fertilizer. Two opposing explanations were offered by the chemists of the day: the older view, coming down from the eighteenth century, was that the fertilizing value

lay in the ash constituents the potash, phosphates, etc., left after the manure is burnt. Lawes and Gilbert considered that it lay in the ash constituents plus the nitrogen of the organic matter, and they devised a critical field experiment to decide the matter. They divided a field of wheat into plots of equal size, of which one received farmyard manure at the rate of 14 tons per acre, another received the ashes of exactly the same dressing of farmyard manure, a third received the mineral matter of the ashes plus some of the combined nitrogen that had been dissipated on burning, and a fourth lay unmanured. The results were very striking :

BROADBALK WHEAT FIELD, 1843.

	Grain Tons per acre	Straw Cwts. per acre
Farmyard manure	22	13
No manure	16	10
Ashes of farmyard manure	16	10
Mineral matter of ash plus sulphate of ammonia to supply combined nitrogen	26 $\frac{1}{4}$	15 $\frac{3}{4}$

The ashes proved ineffective, but the ashes plus the combined nitrogen acted just as well as farmyard manure ; it is therefore these that constitute the fertilizing constituents of the manure. Thus the old controversy was decided in a way not uncommon in science ; neither side proved to be entirely correct, but both sides were found to have some basis of truth. Lawes and Gilbert did not rest content with this purely judicial and scientific conclusion ; they saw that they could make up this effective mixture of ashes and combined nitrogen from mineral substances without using farmyard manure. Even in their day farmers were unable to obtain sufficient farmyard manure, and it was therefore a great achievement to be able to supplement the limited supplies by this mixture. A factory was set up, and the manufacture of the so-called artificial fertilizers began. Subsequent experience showed that the ash constituents are not all equally necessary ; in practice only two of them, potash and phosphates, need be supplied in addition to nitrogen.

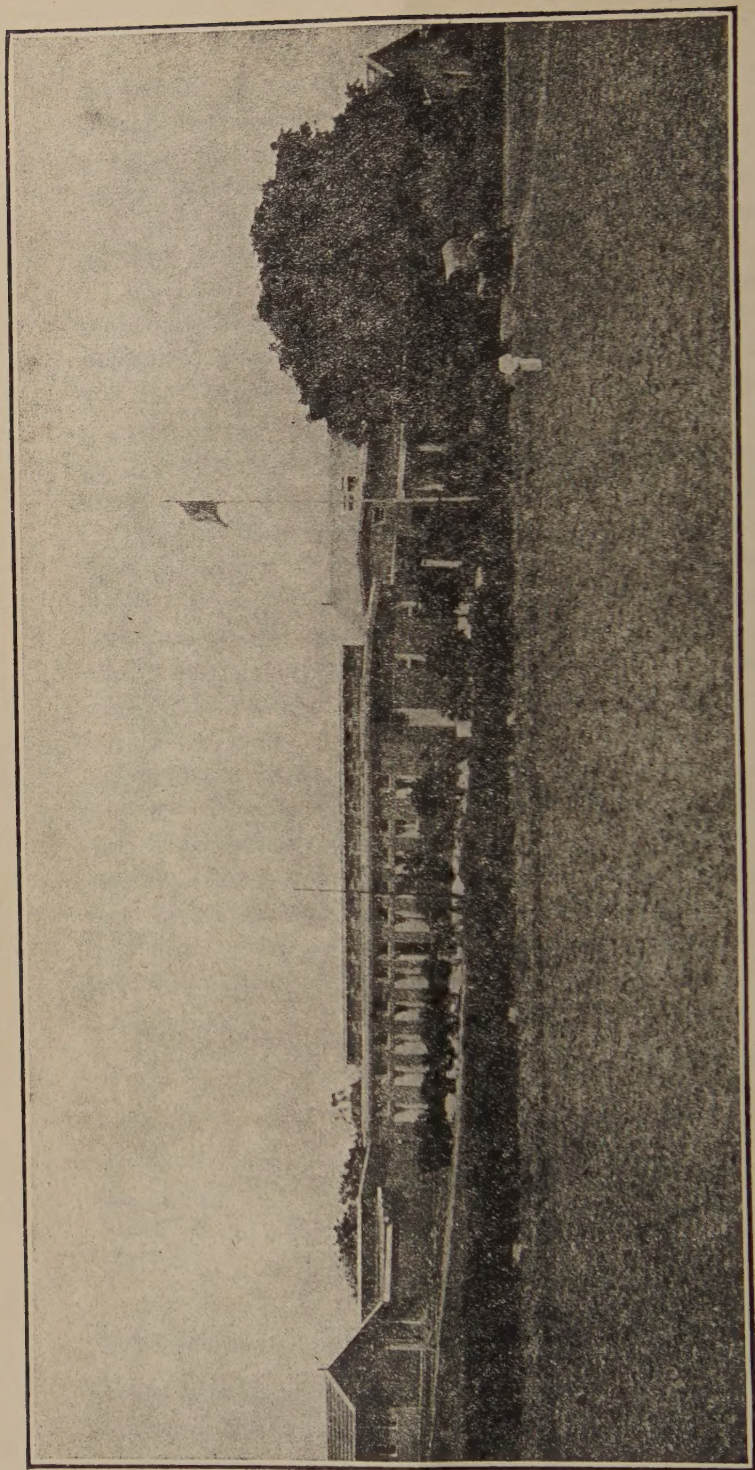
Chemists are rightly proud of artificial fertilizers, for they have proved extraordinarily successful in augmenting crop production all over the world. The demand for them is enormous, and in consequence prices have risen considerably within the last thirty years. Agricultural

chemists are always looking out for new substances, and even during the war a new fertilizer, ammonium chloride, was added to the list and new plant has been erected for its manufacture. Modern manufacturing facilities are, perhaps, adequate for present demands, but it is certain that much more fertilizer could be used, and that as farming improves the demand will increase.

Progressive farmers have long passed the stage when it was necessary to demonstrate that artificial manures increase crop production; the position now is the much more difficult one of deciding how much money it is wise to spend on fertilizers. The old view was that the crop yield was proportional to the manurial dressing — *i.e.*, that the more the manure the bigger the crop. Lawes and Gilbert showed this was not altogether correct, and that the yield fell off after a certain sized dressing was reached; this relationship is expressed by a straight line which ultimately becomes a curve. A later view set up by Mitscherlich was that the effect of the manure is proportional to the decrement from the maximum obtainable; that therefore the first dose of manure has a large effect; but that further doses have progressively less action. This relationship is expressed by a logarithmic curve. The present view is that the effect is at first small; then it increases and then decreases; this relationship is catalysis. The important practical consequence is that moderate dressings are more profitable than much larger ones. There is no difficulty about the general rule; the difficulty arises when one tries to define a moderate dressing. The problem is further complicated by the fact that the effect of the dressing is greatly influenced by the time when it is put on to the land. In our own case the results have been as follows:—

Date of application of manure.	Increased yield of grain Bushels per acre			Increased yield of straw Cwts. per acre		
	Feb. 10	Mar. 6	May 10	Feb. 10	Mar. 6	May 10
Single dressing.	Nil	0·9	2·7	2·7	6·9	9·4
Double dressing.	7·0	..	3·7	11·7	..	12·7

(To be continued.)



VIEW OF THE AGRICULTURAL SCHOOL BUILDING